

# A new species of *Hoplodoris* Bergh, 1880 (Gastropoda: Opisthobranchia: Nudibranchia) from the Atlantic Ocean

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## ABSTRACT

Discodoridid nudibranchs belonging to the genus *Hoplodoris* Bergh, 1880 have not been recorded previously from Atlantic waters. In the present paper a new species found in Illia de Cabo Frio (Cabo Frio Island), Brazil (Arraial do Cabo, State of Rio de Janeiro), is described and illustrated. The new species is compared with other species of *Hoplodoris*. The new species can be distinguished from other species by its distinctive body color pattern and by characters of the reproductive system and radular morphology.

*Additional Keywords:* Brazil, southwestern Atlantic, sea slug, Discodorididae, *Hoplodoris hansrosaorum*.

## INTRODUCTION

Up to now, seven species of *Hoplodoris* Bergh, 1880 are known (Fahey and Gosliner, 2003). Some species had been previously assigned to the genus *Carminodoris* Bergh, 1889. The original descriptions of the genera *Hoplodoris* and *Carminodoris* were done by Bergh (in 1880 and 1889, respectively). However, the incomplete descriptions of type species and the lack of additional specimens since the original descriptions are some of the reasons for the difficulties in undertaking taxonomic research in this group (Fahey and Gosliner, 2003). Since the 1880s, different authors have compiled a list of the distinguishing characters of *Hoplodoris* (Thompson, 1975; Miller, 1991; Valdés, 2002). Fahey and Gosliner (2003) examined discodorid specimens from the type localities and concluded that the genus *Carminodoris* is a junior synonym of *Hoplodoris*; however, later, Dayrat and Gosliner (2005) retained both genera.

The genus *Hoplodoris* has thus far only been found in the Indian and Pacific Oceans. The present study is the first record of *Hoplodoris* from the Atlantic Ocean.

An abbreviation used in the text is MZUSP, for Museu de Zoologia da Universidade de São Paulo (Brazil).

## SYSTEMATICS

Family Discodorididae Bergh, 1891

Genus *Hoplodoris* Bergh, 1880

*Hoplodoris hansrosaorum* new species

(Figures 1–14)

**Description:** EXTERNAL ANATOMY (FIGURES 1, 2): Living animal measuring 27 mm length. Body oval, mantle covered with rounded tubercles. Coloration on central dorsum of living animal orange-brown, becoming whitish-orange toward mantle edge. Rounded orange-brown spots around median dorsum, among rounded tubercles. Opaque white ring present at base of tubercles, tubercle tip pale-orange. Rhinophores orange, terminally with pale-cream tip, rhinophores with approximately 15 lamellae. Branchial leaves six, tripinnate. Two anterior leaves yellowish-cream, two posterior leaves orange. Median leaves with orange base, upper half yellowish-cream. Foot narrow and elongated, with notch on anterior side. Oral tentacles two, short. Color of mantle underside whitish, with several brown orange spots on each side of foot.

BUCCAL ARMATURE (FIGURES 3–13): Radular formula 24×31.0.31. Lateral teeth hook-shaped with denticles along outer margin of cusp (Figure 3, 9). Middle radular teeth with a more elongate cusp with approximately 14 denticles. Inner side of cusp devoid of denticles (Figure 8). Approximately eight outermost lateral teeth usually flat, shaped as elongate plates; plates closely packed together (Figure 10, 11). Each plate surrounded by very fine denticles, plates becoming smaller toward external side of radula (Figures 4, 12). Labial cuticle with elongate jaw rodlets, some rodlets with rounded tips and other irregularly tipped (Figures 5, 13).

REPRODUCTIVE SYSTEM (FIGURES 6, 7, 14): Bulbous anpulla folded into itself. Prostate rounded, lying next to anpulla, narrowing into deferent duct. Deferent duct widening into penial bulb. Bursa copulatrix large, ovate.

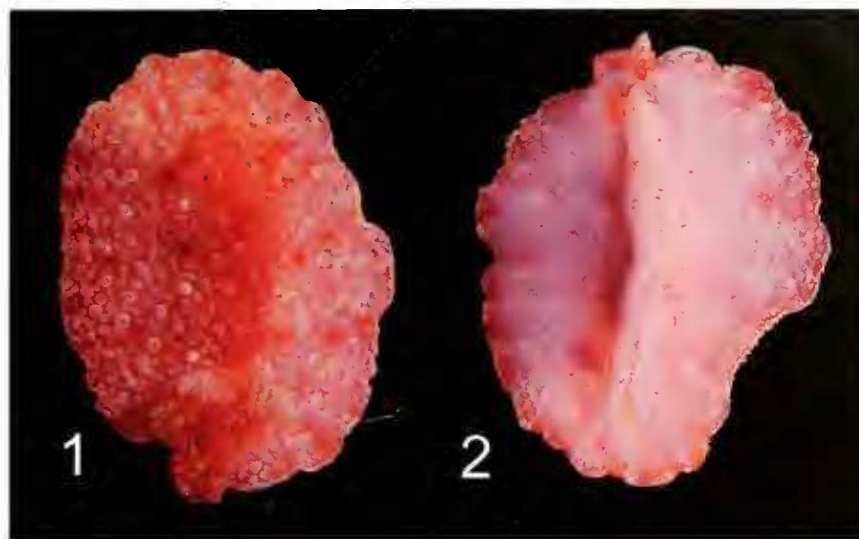
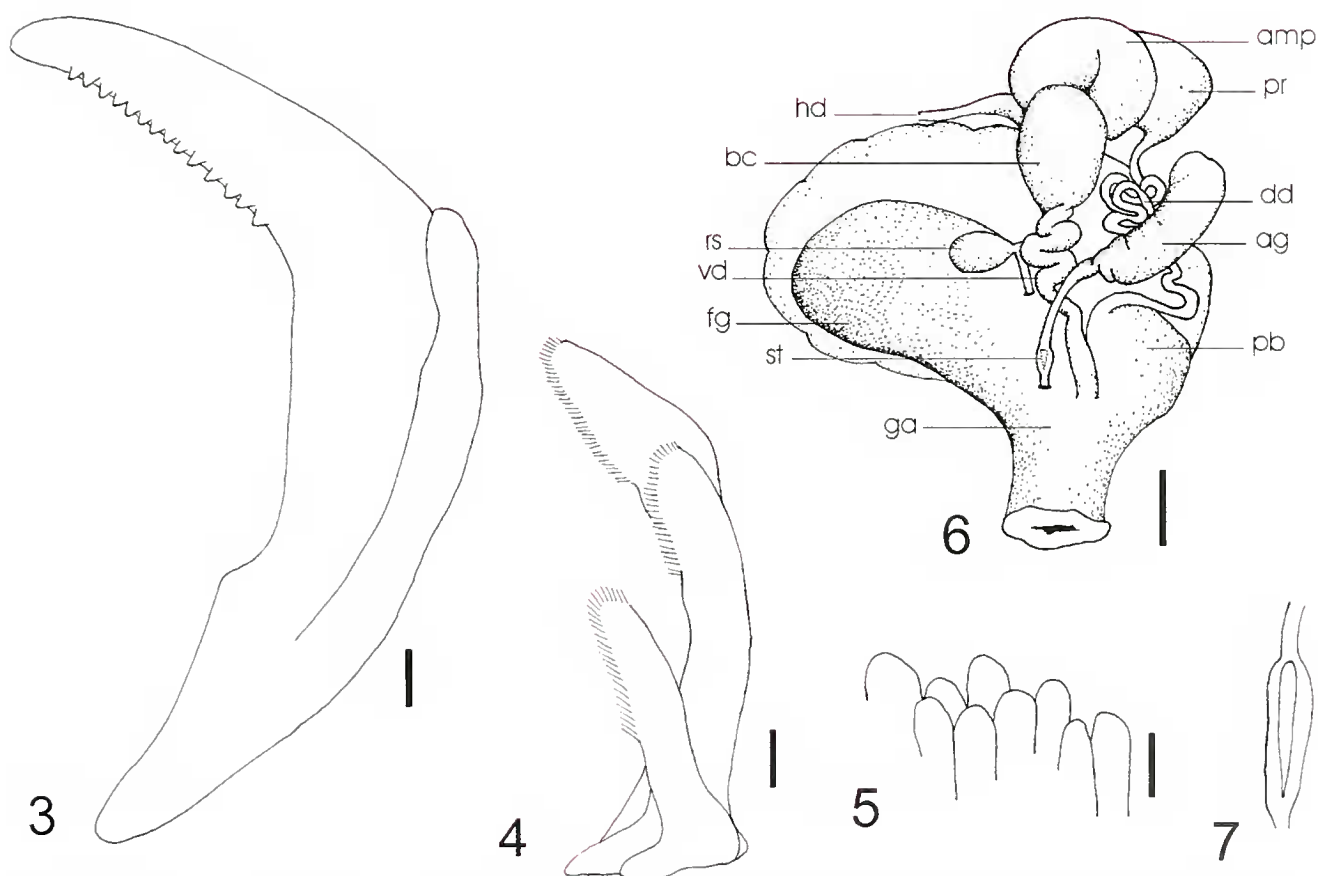
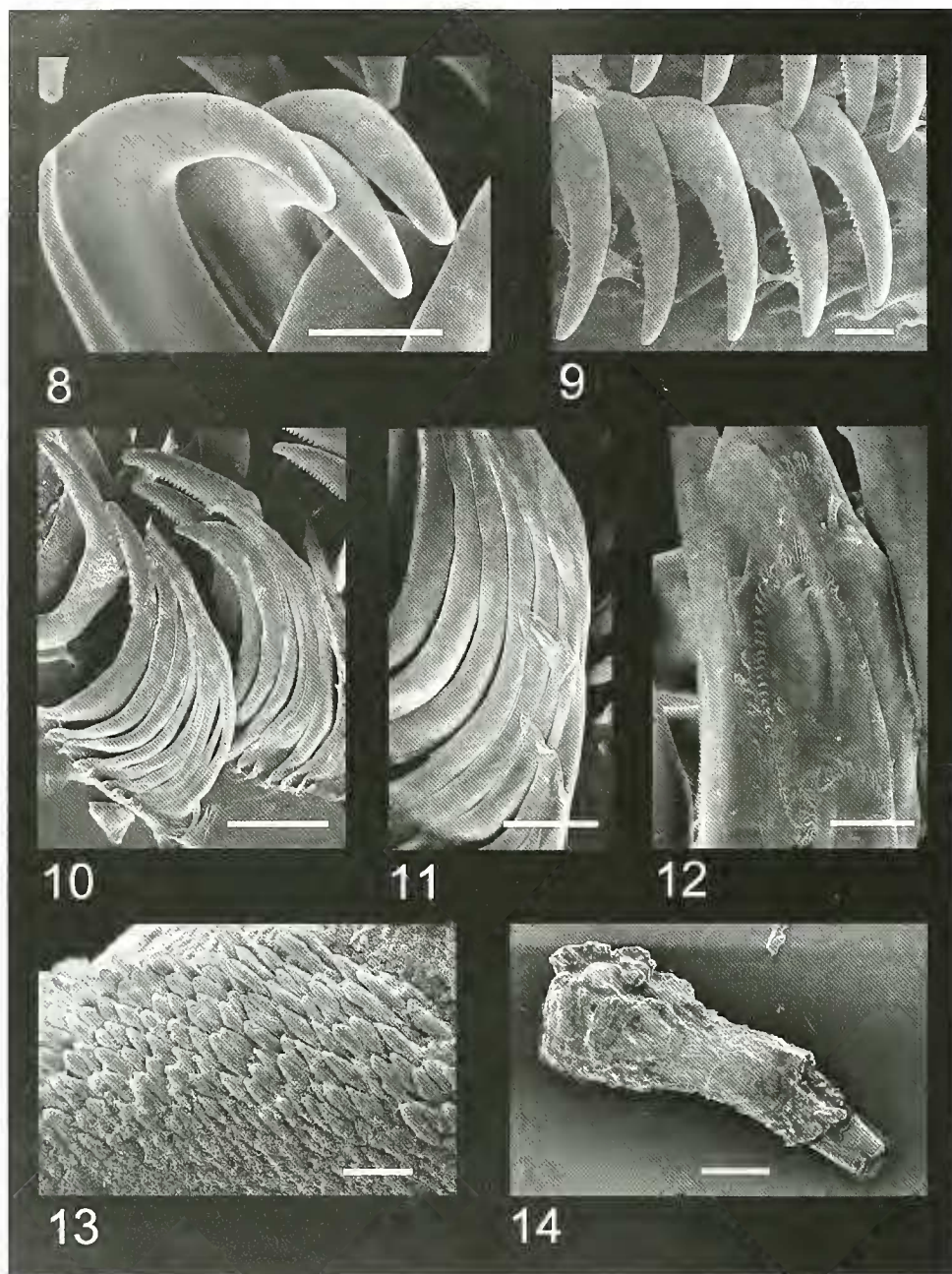


Figure 1–2. *Hoplodoris hansrosaorum*. Living holotype, 27 mm length. 1. Dorsal view. 2. Ventral view.



Figures 3–7. *Hoplodoris hansrosaorum*. 3. Middle lateral tooth showing the denticles. 4. The three outer lateral teeth. 5. Jaw rodlets. 6. Reproductive system (ag: accessory gland; amp: ampulla; bc: bursa copulatrix; dd: deferent duct; fg: female gland; ga: genital atrium; hd: hermaphrodite duct; pb: penial bulb; pr: prostate; rs: receptaculum seminis; st: stylet; vd: vaginal duct). 7. Detail of the accessory gland duct with the stylet. Scale lines (3–5) = 10  $\mu$ m; (6) = 0.5 mm.



**Figures 8–14.** *Hoplodoris hansrosaorum*. 8. Inner lateral teeth, showing the inner margin of the cusp. 9. Middle lateral teeth. 10–12. Outer lateral teeth. 13. Jaw rodlets. 14. Stylet with broken tip. Scale lines (8, 9, 11, 13) = 20  $\mu\text{m}$ ; (10, 14) = 50  $\mu\text{m}$ ; (12) = 10  $\mu\text{m}$ .

Bursa about three times as large as receptaculum seminis. Vaginal duct emerging from base of bursa, thick and looped. (Dissection of the only available specimen did not reveal the presence of genital armature.) Large, elongate accessory gland present, opening into genital atrium. Gland has narrow duct armed with long, tapering stylet (Figures 7, 14).

**Holotype:** MZUSP 52190, 27 mm length, colls. Jesús S. Troncoso and Francisco J. García, 28 July 1999.

**Type Locality:** Collected in the intertidal zone at Ilha de Cabo Frio (Cabo Frio Island), Arraial do Cabo, State of Rio de Janeiro, Brazil.

**Etymology:** The species is named after Hans Bertsch, great friend and malacologist, and his wife Rosa.

#### DISCUSSION

Several characters allocate the species into the genus *Hoplodoris*: species in this genus are characterized by

**Table 1.** Diagnostic characters in species of *Hoplodoris*.

	<i>H. hansrosaorum</i>	<i>H. armata</i>	<i>H. bifurcata</i>	<i>H. bramale</i>
References	Dominguez et al. (present study)	Baba, 1993	Fahey and Gosliner, 2003	Fahey and Gosliner, 2003
Distribution	Brazil	Japan	Hawaii, Japan, Philippines and Okinawa	Pacific Coast of Costa Rica
Ground color of dorsum	Brown orange central dorsum, and whitish orange towards the mantle edge	Yellowish gray with some brown flecks	Gray with mottled shades of darker grays and reddish-browns. Central red-brown band	Brown or tan
Tubercle color	Brown orange, with a white ring at the base	Brown with a white ring basally. Some specimens prominently capped with chocolate brown	With a white ring at the base, followed by a reddish-brown or tan ring, and a white tip	Brown with a white ring at the base
Tubercles morphology	Rounded	Rounded of different sizes	Large, round and tapered	Large and rounded
Rhinophore color	Orange with cream tip	Dark yellowish gray	Tan color with white tip	Brown with a white tip
Branchial leaf color	Anterior leaves, yellow and middle and posterior leaves orange	Darker yellowish gray leaves	Tan with whitish flecks the anterior leaves. Red-brown the posterior	Light tan
Radula	Formula: $24 \times 31.0.31$ . Middle lateral teeth with about 14 denticles. The eight outermost lateral teeth are elongated plates with denticles. No hamate.	Formula: $45 \times 50-60.0.50-60$ . Smooth teeth	Formula: $25 \times 31.0.31$ . Innermost lateral tooth bifid. Middle radular teeth with 5–8 denticles. Two or three outermost teeth shorter and denticulate	Formula: $28 \times 38.0.38$ . Innermost and middle teeth smooth. Two outermost teeth smaller and denticulate
Jaw rodlets	With rounded and irregular tip	Fibrous	Irregularly tipped	Irregularly tipped and with irregular edges
Accessory gland	One long large gland	Two glands	One large and bulbous gland	Two bulbous glands
Receptaculum seminis	Much smaller than the bursa copulatrix	Small and elongate	Much smaller than the bursa copulatrix	About the same size as the bursa copulatrix
Ampulla	Bulbous, doubled on itself	Elongated	Long, thin and tubular	Long, thin and tubular

presence of simple, rounded tubercles covering the dorsum, head with two conical oral tentacles, anterior border of the foot grooved and notched, labial armature armed with jaw elements, radula composed of denticulate hamate teeth, and reproductive system with a large and pedunculated accessory gland armed with copulatory spine (Valdés, 2002).

*Hoplodoris hansrosaorum* new species is externally similar to *H. bramale* Fahey and Gosliner, 2003, and *H. grandiflora* (Pease, 1860) from Indo-Pacific. The mantles of both *H. bramale* and *H. grandiflora* are brown and have tubercles surrounded by a white ring, but *H. hansrosaorum* has a brown-orange central dorsum and is white-orange toward the mantle edge. *Hoplodoris bramale* and *H. grandiflora* have tan or brown rhinophores and gill leaves, whereas the rhinophores of *H. hansrosaorum* are orange and the gill leaves are cream and orange.

Internally, *H. hansrosaorum* differs from *H. bramale*,

particularly in relation to their radular teeth. *Hoplodoris hansrosaorum* has teeth with denticles on the outer margin, and jaw elements with rounded tip, whereas *H. bramale* has teeth devoid of denticles, except for the two outermost ones; the jaw rodlets are irregularly tipped and have irregular edges. Differences in the reproductive system also distinguish the two species. *Hoplodoris bramale* has long and tubular ampulla, two accessory glands, and the receptaculum seminis is about the same size as the bursa copulatrix. However, *H. hansrosaorum* has a thick ampulla, one accessory gland, and the receptaculum seminis is about a third the size of the bursa copulatrix.

The radular teeth of *H. hansrosaorum* and *H. grandiflora* are similar. Both species have lateral teeth with up to 14 denticles on the outer edge of the cusp, and the outer lateral teeth have small denticles. *Hoplodoris hansrosaorum* has approximately eight outermost lateral teeth as plates, which are very close to each other, and each plate is surrounded by very fine denticles. However, *H.*

Table 1. Continued.

<i>H. estrelyado</i>	<i>H. flammea</i>	<i>H. grandiflora</i>	<i>H. nodulosa</i>
Gosliner and Behrens, 1998; Fahey and Gosliner, 2003	Fahey and Gosliner, 2003	Fahey and Gosliner, 2003	Fahey and Gosliner, 2003
Philippine Islands, Western Australia, Vietnam, Indonesia, Marshall Islands, Solomon Islands, Coral Sea	Indonesia	Hawaii, Philippines, Tanzania, Palau, Mauritius, Kerama Island and Madagascar	Eastern Australia, Western Australia and New Zealand
Tan with brown and white specks	Reddish-mottled brown or tan. Bright red central dorsum, with white areas around them	Brown or tan. Some specimens with dark spots near the mantle edge. Others with a dark ring of tubercles on dorsum	Gray to yellows and reddish-browns, with mottled shades of darker hues. Color more distinct on the central dorsum
White patch with yellow center, surrounds a medial group of brown tubercles. Some white, and tan tubercles.	Bright red in the center of the dorsum, with white ring at the base. Reddish- brown tubercles along the mantle edge, some of them with white tip.	Some specimens with areas of white tubercles as perpendicular rays along the mantle edge	On the central dorsum the tubercles have the same coloration of mantle. Tubercles with white ring at base towards the mantle edge
Large tapering tubercles	Large and rounded	Large and rounded	Large, round and tapered
Reddish brown with white specks	Tan and brown with white tip	Light tan with white tip	Tan with a white tip
Tan with brown and white specks	Light gray with tan tips	Light tan with frosted tips	Tan anterior leaves with whitish flecks. The posterior leaves can be a darker color
Formula: $26 \times 65.0.65$ . Innermost lateral teeth with two denticles on outer edge. Middle teeth with up to 11 denticles. Outermost teeth with 6–11 denticles	Formula: $31 \times 50.0.50$ . Innermost lateral tooth with a secondary cusp. Middle lateral teeth with about 8 denticles. Five outermost teeth small and denticulate	Formula: $26\text{--}40 \times$ $40\text{--}116.0.116\text{--}40$ . Innermost lateral teeth with or without denticles. Middle lateral teeth with up to 14 denticles. Two or three outermost teeth hamate with denticles.	Formula: $25 \times 53.0.53$ . Smooth innermost and middle teeth. Four outermost lateral teeth short and denticulate
Irregularly tipped	Irregularly tipped and with knurls along the length	Irregularly tipped	Irregularly tipped
One very large irregularly- shaped gland	One bulbous gland	One long and tubular gland	Two long and bulbous glands
Smaller than the bursa copulatrix	About half the size of the bursa copulatrix	Much smaller than the bursa copulatrix	Much smaller than the bursa copulatrix
Thick and tubular	Long, thin and tubular	Thick and tubular	Long and tubular

*grandiflora* has outer lateral teeth with small denticles, and the two or three penultimate lateral teeth are hamate and much shorter than the rest. The reproductive system of the two species are similar, but the ampulla and the accessory gland of *H. grandiflora* are long and tubular (bulbous in *H. hansrosaorum*).

There are differences between *Hoplodoris hansrosaorum* and other *Hoplodoris* species. For example, the coloration of *Hoplodoris bifurcata* (Baba, 1993) is complex and variegated (Fahey and Gosliner, 2003). The background color in this latter species is gray with mottled shades of darker grays and reddish-browns scattered over the mantle, whereas *H. hansrosaorum* has whitish-orange background color. *Hoplodoris bifurcata* has a red-brown band of color band on the central dorsum, which is lacking in *H. hansrosaorum*. Both species

have a white ring at the base of the dorsal tubercles, but *H. bifurcata* has also a red-brown or tan ring on the tubercles and a white tip. *Hoplodoris bifurcata* has tan and white rhinophores, the anterior gill leaves are tan with whitish flecks of color, and the posterior leaves are red-brown. This coloration differs from that of *H. hansrosaorum*, because the rhinophores are orange with a pale cream tip, and the gill leaves are yellow-cream and orange. Further, the radular morphology differs between these species. The innermost lateral tooth of *H. bifurcata* is bifid, the middle teeth have a cusp with 5–8 denticles, and the 2–3 outermost lateral teeth are denticulate plates. *Hoplodoris hansrosaorum* has an innermost lateral tooth with one cusp, the middle teeth have a cusp with about 14 denticles, and the eight outermost lateral teeth are denticulate plates.

The background color of *Hoplodoris nodulosa* (Angas, 1864) ranges from gray to yellow and reddish-brown; a white ring may be present at the base on the tubercles. That species differs from *H. hansrosaorum* by its tan-colored rhinophores and tan gill leaves with whitish flecks. Furthermore, the four outermost radular teeth of *H. nodulosa* are denticulate (the rest are smooth), and there are two accessory glands in the reproductive system.

Main internal and external morphological characters that can be used to distinguish among the species of *Hoplodoris* are compiled in Table 1.

In relation to geographic distribution, the species *H. grandiflora*, *H. bifurcata*, *H. nodulosa*, *H. bramale*, *H. estrelyado* Gosliner and Behrens, 1998, *H. flammica* Fahey and Gosliner, 2003, and *H. armata* (Baba, 1993), are known only from the Pacific and Indian Ocean. Therefore, *H. hansrosaorum* is the first record of *Hoplodoris* from the Atlantic Ocean.

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